

Claims

[c1] A Braille cell comprising:

- a substantially fluid-tight housing having a top end and a bottom end;
- an opening in the top end of the housing, the opening fluidly sealed with a flexible diaphragm, the flexible diaphragm having a topside and an underside;
- at least two support blocks positioned at the bottom end of the housing;
- a stabilizer block positioned at the bottom end of the housing and positioned between the at least two support blocks;
- an actuator rod having a top end and a bottom end, the top end of the actuator rod secured to the underside of the flexible diaphragm and the bottom end of the rod secured to the stabilizer block; and
- at least two electroactive polymer bending elements, each element having a top edge and a bottom edge, the bottom edge of each of the electroactive polymer bending elements secured to one of the at least two support blocks, the top edge of each of the electroactive polymer bending elements secured to the housing.

- [c2] The Braille cell of claim 1, wherein the housing further comprises:
 - two substantially continuous sides; and
 - two windowed sides, the windowed sides further comprising a support strip positioned to establish a top aperture and a bottom aperture.
- [c3] The Braille cell of claim 2, wherein the two continuous sides are positioned opposite each other and the two windowed sides are positioned opposite each other in the housing.
- [c4] The Braille cell of claim 2, further comprising, four electroactive polymer bending elements, each of the four electroactive polymer bending elements positioned to cover one of each of the top aperture and the bottom aperture of the two windowed sides, wherein one edge of each bending element is secured to the support strip.
- [c5] The Braille cell of claim 1, wherein the housing is substantially rectangular.
- [c6] The Braille cell of claim 1, wherein the housing is filled with a fluid.
- [c7] The Braille cell of claim 6, wherein the fluid is a liquid.
- [c8] The Braille cell of claim 6, wherein the fluid is a gas.

- [c9] The Braille cell of claim 1, wherein the at least two electroactive polymer bending elements are substantially rectangular.
- [c10] The Braille cell of claim 1, wherein the at least two electroactive polymer bending elements are substantially of equal dimension.
- [c11] The Braille cell of claim 1, wherein the electroactive polymer bending element further comprises, an electroactive polymer layer secured to a substantially rigid layer.
- [c12] The Braille cell of claim 11, wherein the electroactive polymer layer comprises an electronic electroactive polymer.
- [c13] The Braille cell of claim 12, wherein the electronic electroactive polymer is a poly vinylidene fluoride, PVDF.
- [c14] The Braille cell of claim 11, wherein the electroactive polymer layer comprises an ionic electroactive polymer.
- [c15] The Braille cell of claim 14, wherein the ionic electroactive polymer is an ionomeric polymer–metal composite.
- [c16] The Braille cell of claim 11, wherein the electroactive polymer layer further comprises:
 - a plurality of photo lithographed microelectrodes, the

microelectrodes placed in alternating fashion having a common positive bus and a common negative bus.

- [c17] The Braille cell of claim 1, further comprising a switchable power supply in circuit communication with the electroactive polymer bending element, the switchable power supply to deliver a voltage to the electroactive polymer bending element sufficient to result in bending of the electroactive polymer bending element.
- [c18] The Braille cell of claim 1, further comprising a Braille dot positioned on the topside of the flexible diaphragm.
- [c19] A Braille cell comprising:
 - a substantially fluid-tight housing having a top end, a bottom end, two facing substantially solid sides and two facing windowed sides, wherein the two facing windowed sides further comprises a support strip positioned to establish a top aperture and a bottom aperture;
 - an opening in the top end of the housing, the opening fluidly sealed with a flexible diaphragm, the flexible diaphragm having a topside and an underside;
 - two support blocks positioned at the bottom end of the housing;
 - a stabilizer block positioned at the bottom end of the housing and positioned between the two support blocks;
 - an actuator rod having a top end and a bottom end, the

top end of the actuator rod secured to the underside of the flexible diaphragm and the bottom end of the rod secured to the stabilizer block;

a Braille dot positioned on the topside of the flexible diaphragm;

four electroactive polymer bending elements, the bending elements substantially of equal dimensions, each bending element having a top edge and a bottom edge;

a first two of the four electroactive polymer bending elements positioned to cover a bottom aperture of a windowed side, the bottom edge of the first two electroactive polymer bending elements secured to one of the at least two support blocks, the top edge of each of the first two electroactive polymer bending elements secured to the support strip; and

a second two of the four electroactive polymer bending elements positioned to cover a bottom aperture of a windowed side, the top edge of the first second electroactive polymer bending elements secured to the top of the housing, the bottom edge of each of the second two electroactive polymer bending elements secured to the support strip.

[c20] A Braille cell comprising:

a substantially fluid-tight housing having a tactile member cover, the tactile member cover positioned on a top

surface of the housing;
a tactile member in the housing, the tactile member being movable between a neutral position at which the tactile member is substantially flush with the tactile member cover and is not palpable and a reading position at which the tactile member is extended beyond the tactile member cover and is palpable;
a support member in the housing for supporting the tactile member when the member is in the reading position;
an actuator integrally connected to the support member for moving the tactile member between a neutral position and a reading position through the displacement of fluid within the substantially fluid-tight housing, the actuator actuated by an electrical voltage and further comprising, an electroactive polymer which bends upon application of an electrical voltage, the bending of the electroactive polymer to displace a fluid volume within the housing sufficient to move the tactile member between a neutral position and a reading position, the bending of the electroactive polymer sufficient to move the support member to support the tactile member when in the reading position.

[c21] A Braille display apparatus comprising a plurality of Braille cells, each Braille cell comprising a substantially fluid-tight housing, the fluid-tight housing further com-

prising a tactile member cover, a tactile member in the housing, the tactile member being movable between a neutral position at which the tactile member is substantially flush with the tactile member cover and is not palpable and a reading position at which the tactile member is extended beyond the tactile member cover and is palpable, a support member in the housing for supporting the tactile member when the member is in the reading position, an actuator integrally connected to the support member for moving the tactile member between a neutral position and a reading position through the displacement of fluid within the substantially fluid-tight housing, the actuator actuated by an electrical voltage and further comprising, an electroactive polymer which bends upon application of an electrical voltage, the bending of the electroactive polymer to displace a fluid volume within the housing sufficient to move the tactile member between a neutral position and a reading position, the bending of the electroactive polymer sufficient to move the support member to support the tactile member when in the reading position.